

Elvis the Ailing Elephant

Brief Overview:

This lesson introduces the concepts of mode, median, range, clusters, outliers, and line plots. It is expected that the students have experience with data collection and other types of graphing.

During this lesson, each student will become a zookeeper of an elephant at the zoo. He/she will be provided with data on his elephant, which he will share with the group. This data will help the class understand the norms of the elephants at the zoo, which will lead to a solution to help Elvis, the ill elephant, get healthy.

NCTM Content Standard/National Science Education Standard:

Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them

- Represent data using tables and graphs such as line plots, bar graphs, and line graphs

Select and use appropriate statistical methods to analyze data

- Describe the shape and important features of a set of data and compare related data sets, with an emphasis on how the data are distributed;
- Use measures of center, focusing on the median, and understand what each does and does not indicate about the data set;

Develop and evaluate inferences and predictions that are based on data

- Propose and justify conclusions and predictions that are based on data and design studies to further investigate the conclusions or predictions.

Grade/Level:

Grades 3-4

Duration/Length:

Three class sessions, approximately 75 minutes per session

Student Outcomes:

Students will:

- Represent and organize given data using a line plot
- Analyze data distribution
- Calculate and describe the purposes of the mode, median, and range

- Analyze data using the mode, median, and range
- Compare one piece of data to the population norms to draw conclusions
- Make predictions and test their validity

Materials and Resources:

Day 1

- 30 Elephant Data Cards (Student Resource 1) *Note – All thirty cards must be represented for the analysis in this lesson to be accurate. The teacher may model the excess cards for the students. Elvis' card may be used by the teacher, or assigned to a student.
- 1 sheet of poster or bulletin board paper (any color) * Note – The teacher may choose to use masking tape to create the line for the line plot and should be sure to add arrows to the end of each line.
- Markers
- Completed line plots – Teacher Resource 1A
- Line plots or graphs from Teacher Resource 2 (Identifying mode) *Note – The teacher may choose to make a poster or overhead from this information to help his/her students visually.
- Exit card - Student Resource 2A (2 per sheet, ½ sheet per child)

Day 2

- 30 Elephant Data Cards (Student Resource 1)
- 1 sheet of poster or bulletin board paper (any color) * Note – The teacher may choose to use masking tape to create the line for the line plot and should be sure to add arrows to the end of each line.
- Markers
- Completed line plots – Teacher Resource 1A
- Exit card - Student Resource 2B (2 per sheet, ½ sheet per child)
- Class line plot from Day 1
- Number cards from Teacher Resource 4
- Group worksheet on food data analysis – Student Resource 3 (1 per child or group)

Day 3

- 30 Elephant Data Cards (Student Resource 1)
- Completed line plots – Teacher Resource 1B
- Class line plots from Days 1 and 2
- Tic-Tac-Toe directions – Teacher Resource 3
- Coins or markers for Tic-Tac-Toe
- Clipboards (1 per student)
- Plain paper (2 sheets per student)
- Checklist for line plot – Student Resource 5 (2 per sheet, ½ sheet per child)

- Line plot template – Student Resource 4 (1 per student)
- Summative assessment – Student Resource 6 (1 per student)
- Answer key for summative assessment – Teacher Resource 5
- Information about African Elephants was found at the following websites:
 - <http://www.sanparks.org/parks/kruger/elephants/about/faq.php>
 - <http://www.pbs.org/edens/etosha/elephant.htm>

Development/Procedures:

Lesson 1

Pre-Assessment/Launch

- Tell the students that you have a new job as the head zookeeper and the students have new jobs as employees at the zoo. As employees at the zoo, they each have the responsibility to take care of and monitor one elephant. All of the elephants have a similar height and weight. Unfortunately, one of the elephants, Elvis, is sick. As the head zookeeper, tell students that you called the veterinarian, Vicki the Vet. Vicki came and thoroughly examined Elvis. She started to explain the problem. She said, “Elvis is sick because he didn’t get enough ___” She stopped talking because her phone rang. She was told of an emergency at another zoo. A monkey had his head stuck in a coconut. She had to leave right away and was unable to help Elvis. As the head zookeeper, you will need help from the other zoo employees.
- Vicki the Vet said that Elvis wasn’t getting enough of something he needs to be healthy. It is known that he has the shelter he needs. Have the class discuss the other basic needs Elvis has (sleep, food, and water).
- Tell the students that the class will first look at the amount of sleep Elvis gets each day to see if his problem may be that he is getting too little sleep. Ask the students: “As the zoo employees, what could you do to find out if Elvis is sleeping a normal amount of hours?”

Teacher Facilitation/Student Application

- Tell the students that you observed Elvis and found that he sleeps 4 hours a day. Have the students make and share predictions about the normalcy of his sleep.
- Each child will represent one elephant. They will share the data from their elephant’s data card. Give each child the data card for his/her elephant (Student Resource 1).
- Have each student report the sleep data for his elephant and record this on a chart on the board.
- Discuss the data with the students. Ask them if they find it easy to analyze the data in the form that it is written. Have the students share their ideas for alternative data representations and lead them to the conclusion that a line plot would be easy to understand.
- Tell the students that to create a line plot they will first need to find the range. This is done by finding the smallest number and the largest number. These will be the starting and ending points on the line. The range, or difference of

these two numbers, tells you how many spaces for numbers will be on the line.

- Model the steps for creating a line plot on the poster or bulletin board paper. Explain the importance of labeling, spacing, and making uniform x's when creating a line plot.
- Allow each student to come to the board to mark the data for his/her elephant on the line plot. As they do this, put a slash through the same data that is represented on the original data chart. Explain to the students that doing this helps one ensure that all of the data has been represented on the graph. Once all of the data has been plotted, count the number of data entries on the original chart and on the line plot. Tell the students that by making sure these amounts match, they will be able to check that they have included all of the data points.
- Explain that when analyzing data from line plots one looks at clusters, gaps, and outliers. A cluster is a grouping of data that falls very closely on the line plot. An outlier is a data point that is very far from other data points on the line plot. A gap is a space between data points. As a class, identify the clusters and outliers. Ask a question such as: Binky slept eleven hours, is that normal? Use the line plot to explain your answer (See Teacher Resource 1 a)..
- Using the line plot, ask the students the following questions:
 - Is Elvis sleep deprived? How can you use this information to support your answer?
 - What does this data tell us about the habits of the other elephants?
- Explain that another method used to analyze data is the central tendency of the data.. Students can find the mode(s) by looking at the most repeated data points. As a class, identify the mode.
- Use Teacher Resource 2 a-b to practice identifying and describing the mode. Use the following questions to facilitate your discussion:
 - The mode is _____. What does that mean?
 - If the mode is _____, where would your data fall? Would you be an outlier or in a cluster? How could you use this information? (The students could use this information to persuade their parents to raise their allowance, eat more sweets, or that they have acceptable grades.)
 - Continue using Teacher Resource 2, and ask the students how they can find the total population surveyed (count the x's).

Embedded Assessment

After the class discussion, give each student an exit card. They will answer the question, “Do you think Elvis was sick because he didn’t get enough sleep? Use data to support your answer.” (Student Resource 2A)

Reteaching/Extension

- Depending on the students’ levels, you may choose to have them create pictographs or bar graphs for this three-day lesson.
- The exit card can be changed to meet the students’ individual levels. Higher level students can analyze their elephants’ data in comparison to the norm.

- The exit card could also be used for the class discussion, during which you make anecdotal notes of student responses.
- Use line plots or various types of graphs when analyzing the mode in Teacher Resource 2.

Lesson 2

Pre-Assessment/Launch

- As a class, review the line plot created yesterday.
- You may use the following questions to facilitate the discussion:
 - Why do researchers look at the range, mode, outliers, and clusters?
 - How would the meaning of the data change if there was a shorter range? How would it change if there was a longer range?
 - Do you consider the range, mode, outliers, or clusters the most important? Why?
 - How should the class continue to investigate the problem since sleep deprivation was ruled out?
- After discussing range, mode, outliers, and clusters during the launch, ask the students if they think there is another way mathematicians could look at the data.

Teacher Facilitation/Student Application

- Show the students that finding the middle number gives us the median. Demonstrate this by giving each student a number card (Teacher Resource 4 a-c) that matches the amount of food his/her elephant ate. Have the students with the smallest and largest number stand at opposite ends of the room. Have the remaining students line up in order between them. Then, have the students that are the very last on each side of the line sit down. Continue this until only one student is left. This is your median. If an even number of data is used, find the number that falls between the middle two numbers (their average). After finding the median with the students, model how to find the median on the line plot. *Note –You may choose to use part of the class for this demonstration.
- Begin the investigation of how much food the elephants eat by having each child report how much food his elephant eats. Elicit student responses to find the range and to set up the line plot (including title, labels, and increments).
- In groups of four, have the students find the clusters, outliers, mode, and median (Student Resource 3). They should also discuss how this information affects Elvis. See Teacher Resource 1 b.
- As a class, review how the clusters, outliers, mode, and median relate to the outcome for Elvis. Use the following questions to facilitate the discussion:
 - Which measure represents the more typical amount of food eaten? *Note – The median represents the more typical amount because it looks at the entire population surveyed.
 - What would Elvis' food intake have to be for you to consider it as a potential problem? How did you determine your answer?
 - Are there any elephants that you are concerned about? Why?

- Is Elvis' illness related to how much food he eats? Use information from the line plot to explain your answer.

Embedded Assessment

Have the students use the exit sheet or write a journal entry answering the question, "If you were the head zoo keeper, would you look at the mode or the median when ordering food for the elephants? Explain your answer" (Student Resource 2b).

Reteaching/Extension

- For students who do not have a strong concept of place value, you may choose to review place value for numbers 100-999 before this lesson.
- An alternative to counting the x's to find the median is to list the data in increasing order and crossing off the numbers on each end until the center number is reached.
- You could choose to introduce finding the median with an even number of data points where the middle two numbers are not the same. For example, {3,6,7,9,10,11}, the median is between 7 and 9. Show students that the median is midway, or at 8.

Lesson 3

Pre-Assessment/Launch

- Review the vocabulary presented during this lesson by playing Vocabulary Tic-Tac-Toe. (Teacher Resource 3).
- After the game and vocabulary review, ask the students to explain how knowing the range of the data helps them create a line plot.

Teacher Facilitation/Student Application

- Have the students place their elephant data card on their desks. Using a clipboard, have students rotate around the classroom to collect the data of how much each elephant drank. Data can be collected on plain paper.
- Students will use data to create a line plot and use the checklist to ensure that it includes all of the required components (Student Resource 5). See Teacher Resource 1 b for answers.

Embedded Assessment

- After completing their line plots, students will identify the range and answer the following question informally: "What is wrong with Elvis? Use data to support your answer."
- Continue the discussion by reviewing the sleep, food, and water line plots (use a student example for the water line plot). Require the students to support their reasoning by using information from the line plots. They should use appropriate vocabulary. Facilitate the discussion using the following questions:
 - Compare and contrast the data distribution of the three line plots.

- Based on the data, would you make a recommendation for your elephant regarding sleeping, eating, and drinking?
- How would you describe the typical day of an elephant?

Reteaching/Extension

- If it is more appropriate for the students, have each student write the water intake for his/her elephant on the back of the card to make it easier for other students to record.
- Facilitate a small group during independent work time for students who need extra support.
- For additional vocabulary review, prepare post-it notes with vocabulary words that the class will place on the line plots next to the example. For example, on the Sleep Data Line Plot one may place a post-it labeled “outlier” next to the x at number eleven.

Summative Assessment:

The students will be presented with data from a new survey (Student Resource 6). They will be required to make a line plot with the data using appropriate scale, range, and labeling. Then they will identify the mode, median, range, outliers, gaps, and clusters and use this information to analyze the data and answer a question. The fourth question on the assessment is a challenging extension. Include this if it is appropriate for your students.

*Note – You may choose to allow the students to use the line plot checklist (Student Resource 5) when completing the assessment. See Teacher Resource 5 a-c for an answer key.

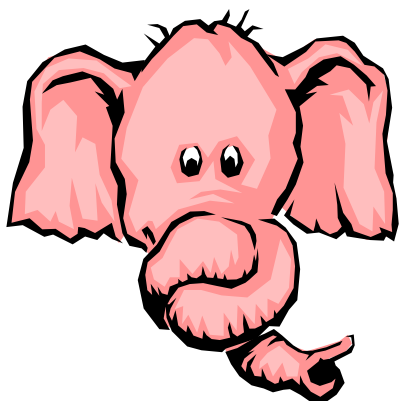
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Student Resource 1A
Elephant Data Cards

Name: Elvis

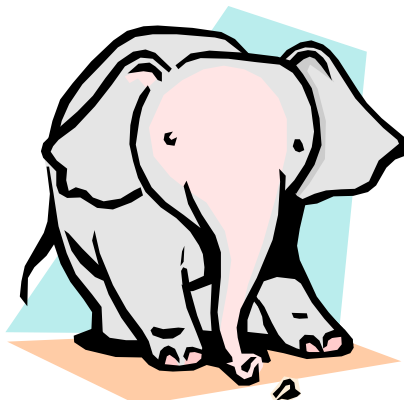


Sleep: 4 hours

Food: 300 pounds

Water: 220 liters

Name: Bobo

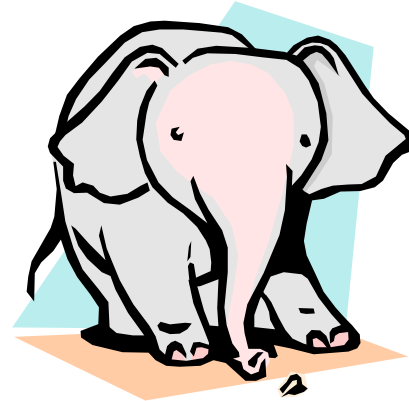


Sleep: 4 hours

Food: 320 pounds

Water: 230 liters

Name: Bongo

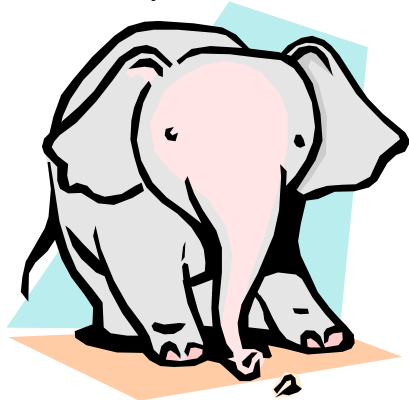


Sleep: 5 hours

Food: 220 pounds

Water: 227 liters

Name: Betsy

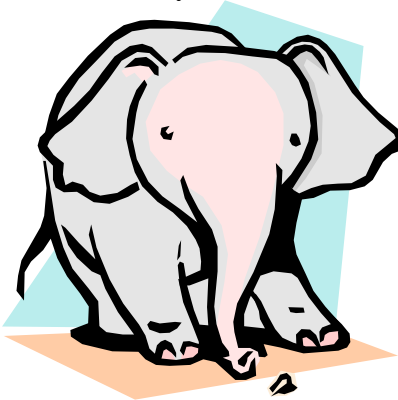


Sleep: 6 hours

Food: 310 pounds

Water: 231 liters

Name: Billy

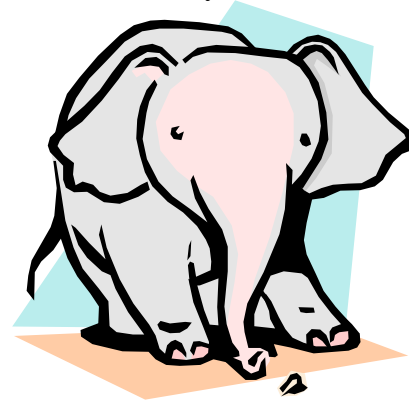


Sleep: 4 hours

Food: 250 pounds

Water: 226 liters

Name: Brittany



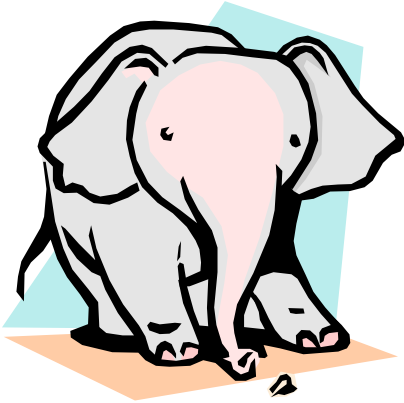
Sleep: 2 hours

Food: 200 pounds

Water: 225 liters

Student Resource 1B
Elephant Data Cards

Name: Babs

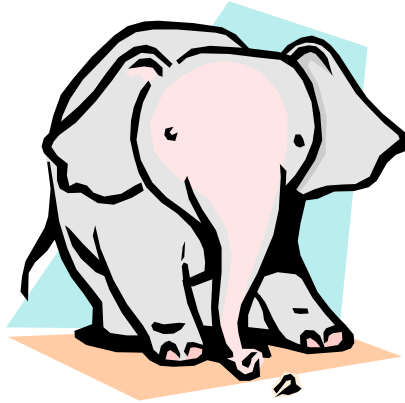


Sleep: 4 hours

Food: 240 pounds

Water: 227 liters

Name: Baby-doll

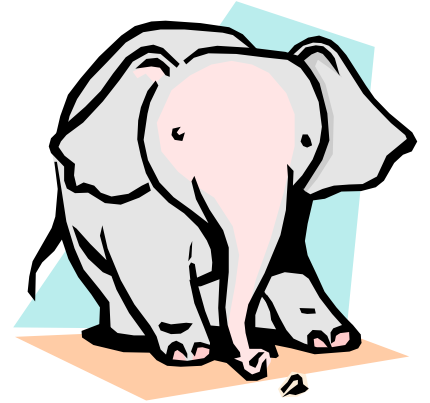


Sleep: 6 hours

Food: 260 pounds

Water: 228 liters

Name: Badges

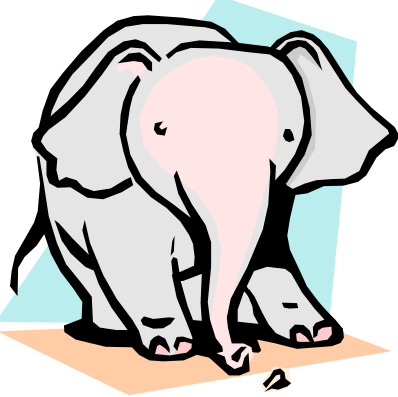


Sleep: 6 hours

Food: 220 pounds

Water: 226 liters

Name: Baja

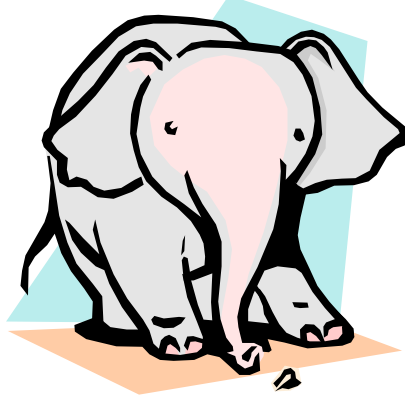


Sleep: 3 hours

Food: 320 pounds

Water: 228 liters

Name: Baluga

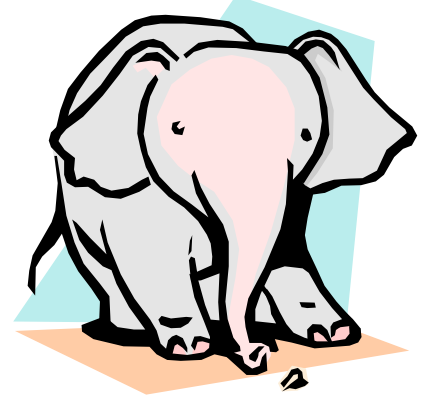


Sleep: 4 hours

Food: 240 pounds

Water: 227 liters

Name: Bam-Bam



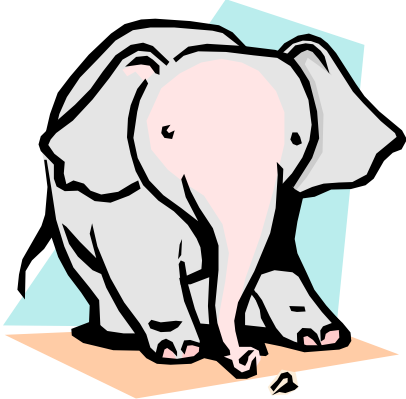
Sleep: 4 hours

Food: 330 pounds

Water: 227 liters

Student Resource 1C
Elephant Data Cards

Name: Barry

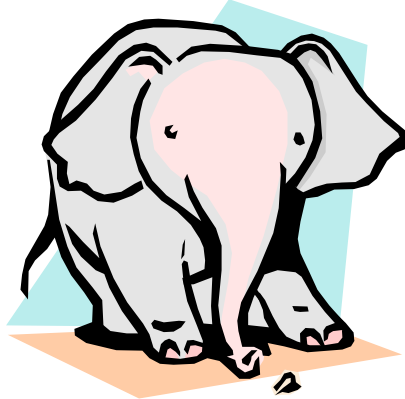


Sleep: 3 hours

Food: 260 pounds

Water: 228 liters

Name: Basil

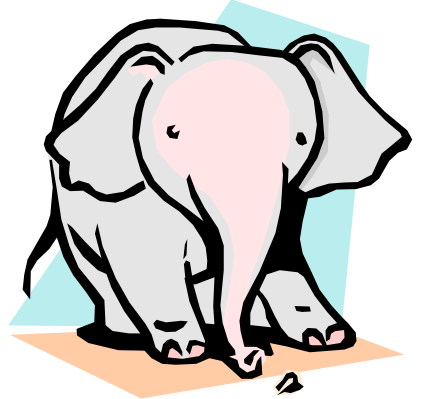


Sleep: 4 hours

Food: 260 pounds

Water: 230 liters

Name: Bashful

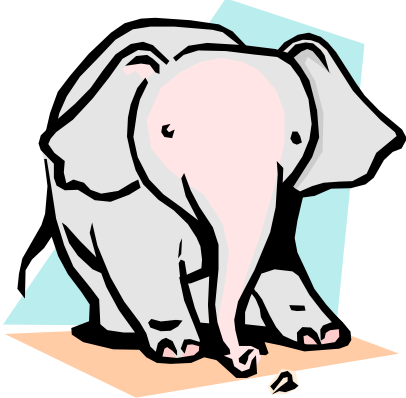


Sleep: 6 hours

Food: 230 pounds

Water: 227 liters

Name: Baxter

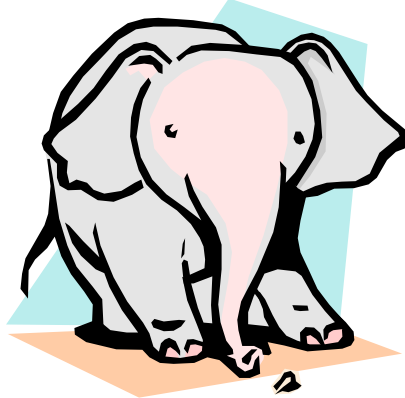


Sleep: 5 hours

Food: 320 pounds

Water: 226 liters

Name: Beethoven

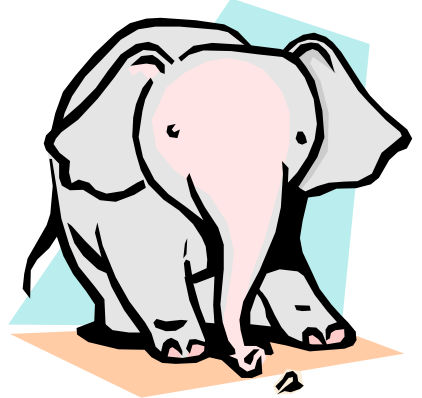


Sleep: 4 hours

Food: 270 pounds

Water: 231 liters

Name: Beauty



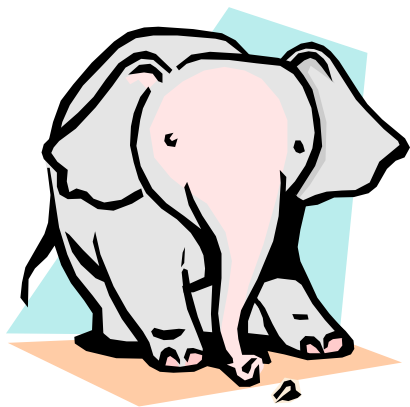
Sleep: 3 hours

Food: 320 pounds

Water: 225 liters

Student Resource 1D
Elephant Data Cards

Name: Bernie

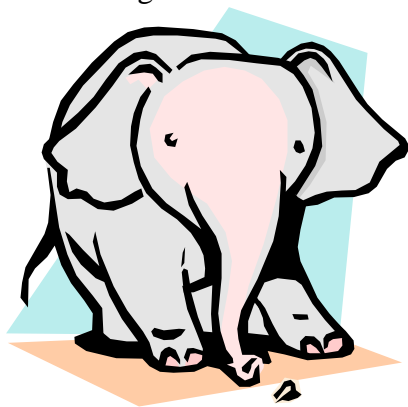


Sleep: 2 hours

Food: 250 pounds

Water: 231 liters

Name: Bigfoot

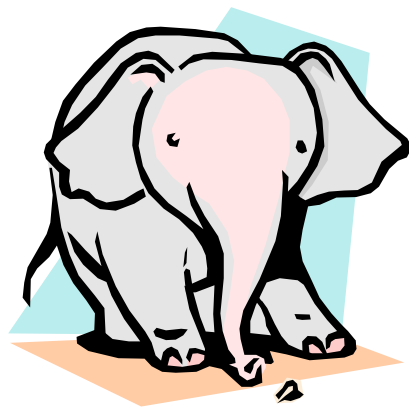


Sleep: 6 hours

Food: 320 pounds

Water: 228 liters

Name: BJ

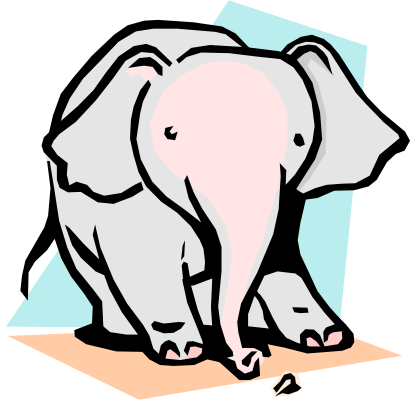


Sleep: 5 hours

Food: 270 pounds

Water: 227 liters

Name: Blossom

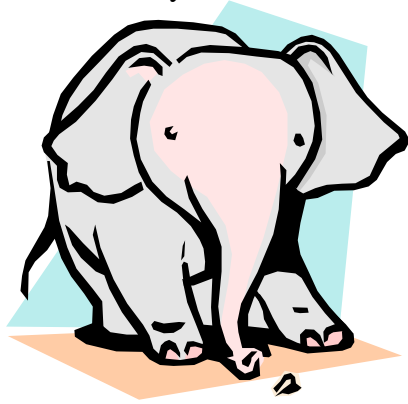


Sleep: 5 hours

Food: 230 pounds

Water: 227 liters

Name: Binky

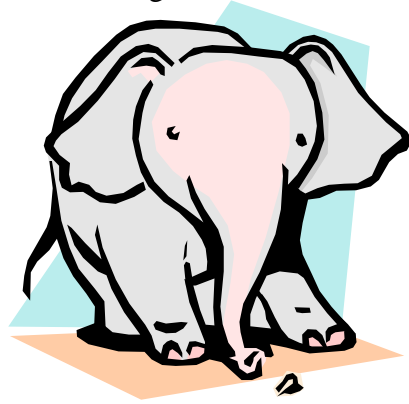


Sleep: 11 hours

Food: 240 pounds

Water: 232 liters

Name: Bogart



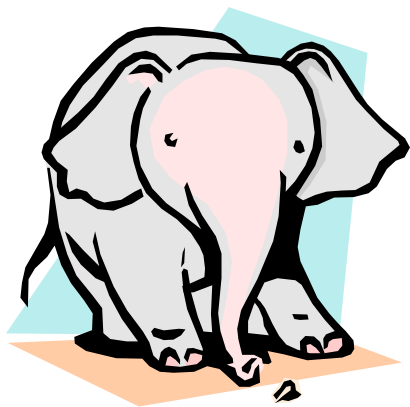
Sleep: 3 hours

Food: 250 pounds

Water: 226 liters

Student Resource 1E
Elephant Data Cards

Name: Bonzai

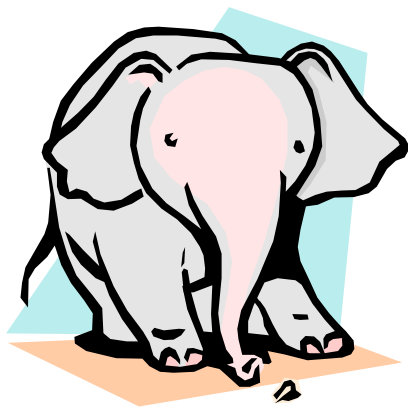


Sleep: 2 hours

Food: 220 pounds

Water: 229 liters

Name: Boom-Boom

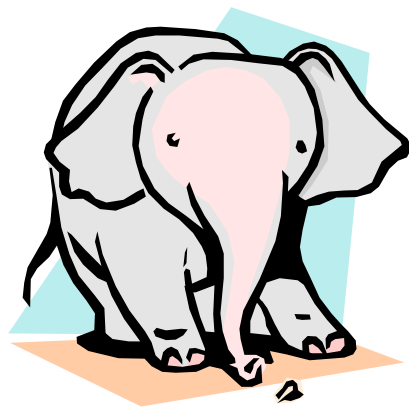


Sleep: 5 hours

Food: 220 pounds

Water: 226 liters

Name: Bowser

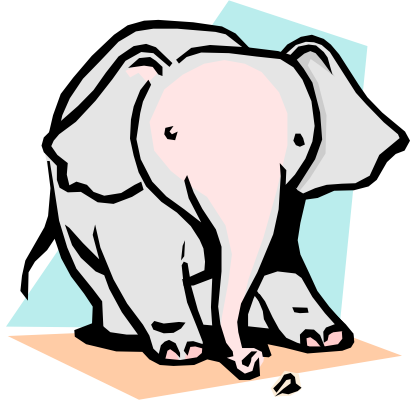


Sleep: 3 hours

Food: 270 pounds

Water: 225 liters

Name: Boxie

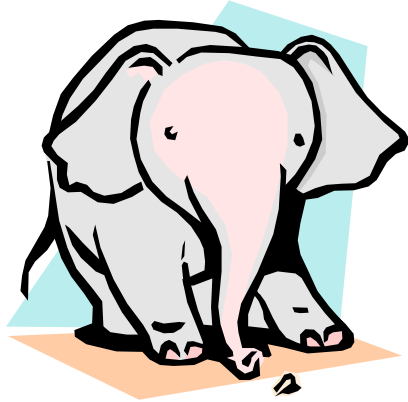


Sleep: 4 hours

Food: 300 pounds

Water: 226 liters

Name: Brook

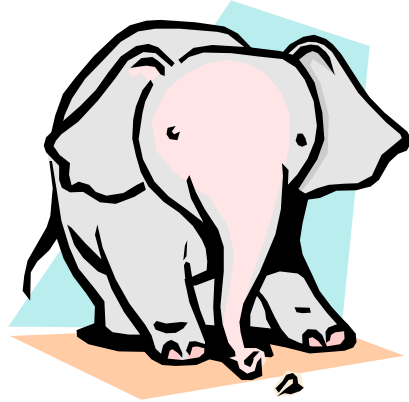


Sleep: 5 hours

Food: 310 pounds

Water: 227 liters

Name: Bruno

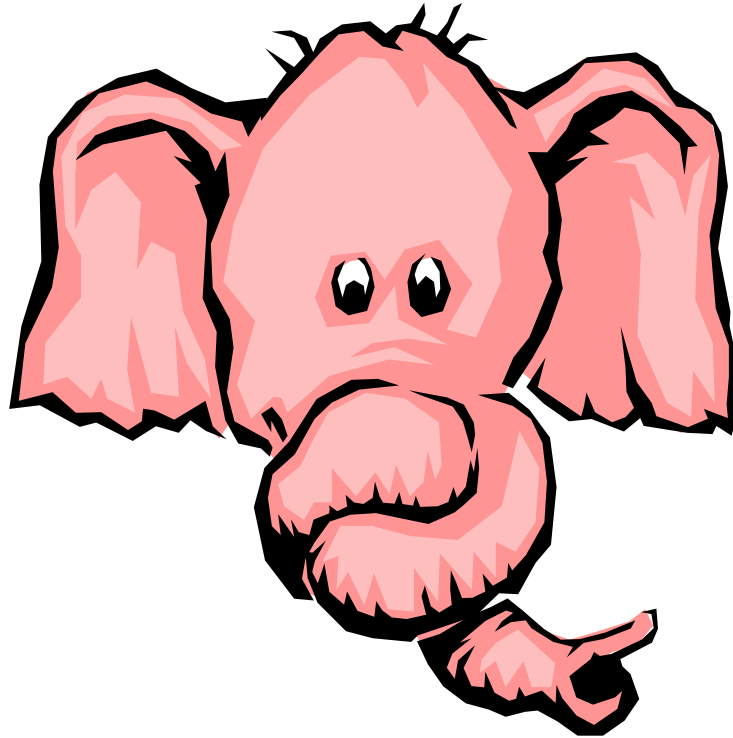


Sleep: 6 hours

Food: 320 pounds

Water: 228 liters

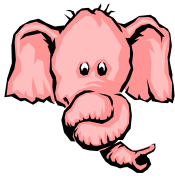
Name: Elvis



Sleep: 4 hours

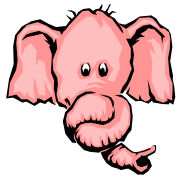
Food: 300 pounds

Water: 220 liters



Student Resource 2A
Exit Card Questions
Day 1

Do you think Elvis was sick because he didn't get enough sleep? Use data to support your answer.



Student Resource 2A
Exit Card Questions
Day 1

Do you think Elvis was sick because he didn't get enough sleep? Use data to support your answer.



Student Resource 2B
Exit Card Questions
Day 2

If you were the head zookeeper, would you look at the mode or the median when ordering food for the elephants? Explain your answer.



Student Resource 2B
Exit Card Questions
Day 2

If you were the head zookeeper, would you look at the mode or the median when ordering food for the elephants? Explain your answer.

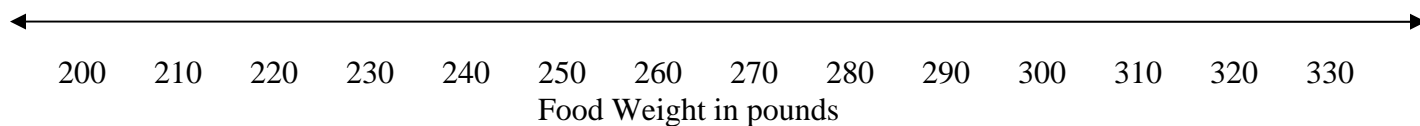
Name _____

Partner's Name _____

Partner's Name _____

Partner's Name _____

1. Make a line plot showing the amount of food the elephants ate.

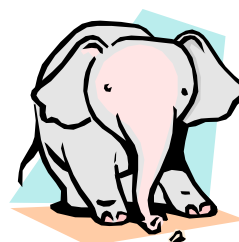


2. Determine the measures below:

Range = _____ pounds

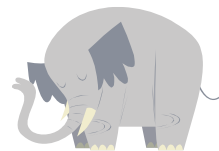
Mode = _____ pounds

Median = _____ pounds

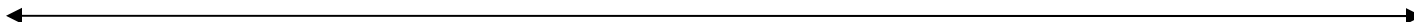


3. There are 2 clusters on this line plot. What do you think that reflects? Explain.

Name _____



1. Make a line plot showing the amount of water the elephants drank.





Line Plot Checklist

I included . . .

☐

A title

☐

Equal spacing

☐

Xs that are the same size

☐

A labeled number line

☐

All of the data



Line Plot Checklist

I included . . .

☐

A title

☐

Equal spacing

☐

Xs that are the same size

☐

A labeled number line

☐

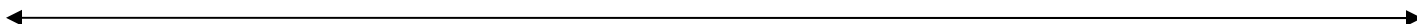
All of the data

Name _____

Data: Bananas Eaten in a Day by the Zoo's Monkeys

{8, 5, 9, 11, 10, 9, 10, 8, 10, 10, 9, 10, 9}

2. Make a line plot showing the amount of bananas the monkeys ate.

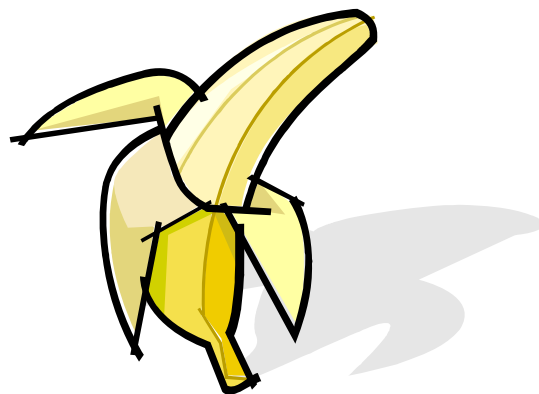


4. Determine the measures below:

Range = _____ bananas

Mode = _____ bananas

Median = _____ bananas



5. There is one outlier in this data. Explain why this may have occurred.

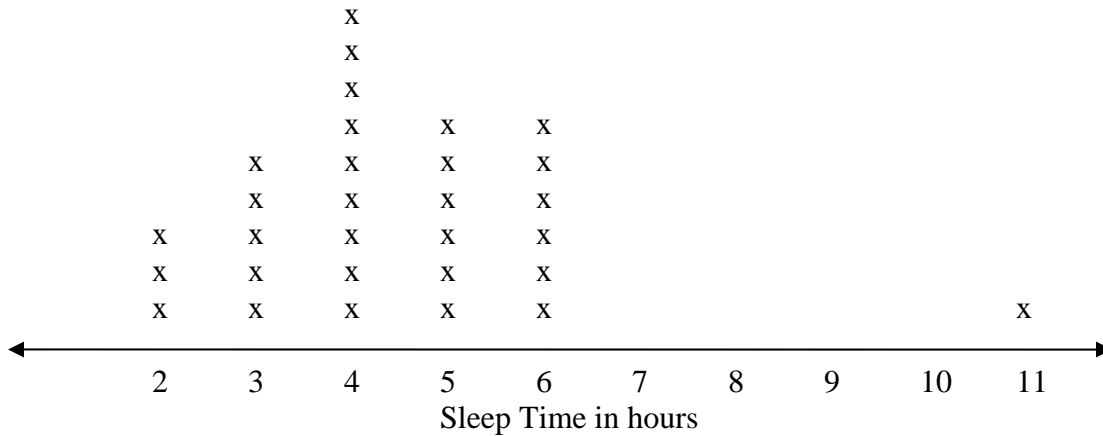
Extension:

6. You are the Monkey House Manager. Write a letter to the head zookeeper about how many bananas the typical monkey eats in a day. She will need to order next week's food. Help her understand how much she should order for the whole week.

[illegible]

Sleep Data Line Plot

{2,2,2,3,3,3,3,3,4,4,4,4,4,4,4,4,5,5,5,5,5,5,6,6,6,6,6,6,11}



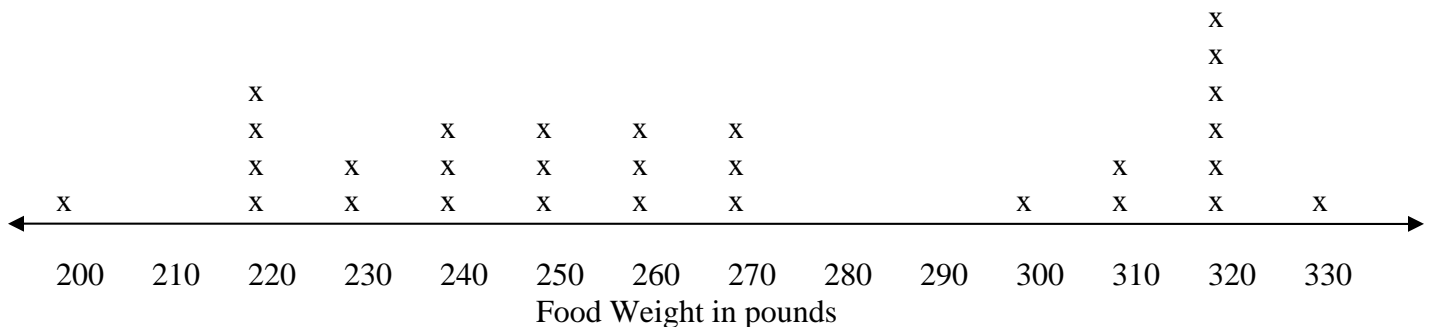
Range = 9 hours

Mode = 4 hours

ELVIS: 4 hours

Food Data Line Plot

{200, 200, 200, 220, 220, 220, 220, 230, 230, 240, 240, 240, 250, 250, 250, 260, 260, 270, 270, 270, 300, 310, 310, 320, 320, 320, 320, 320, 320, 330}



Range = 130 pounds

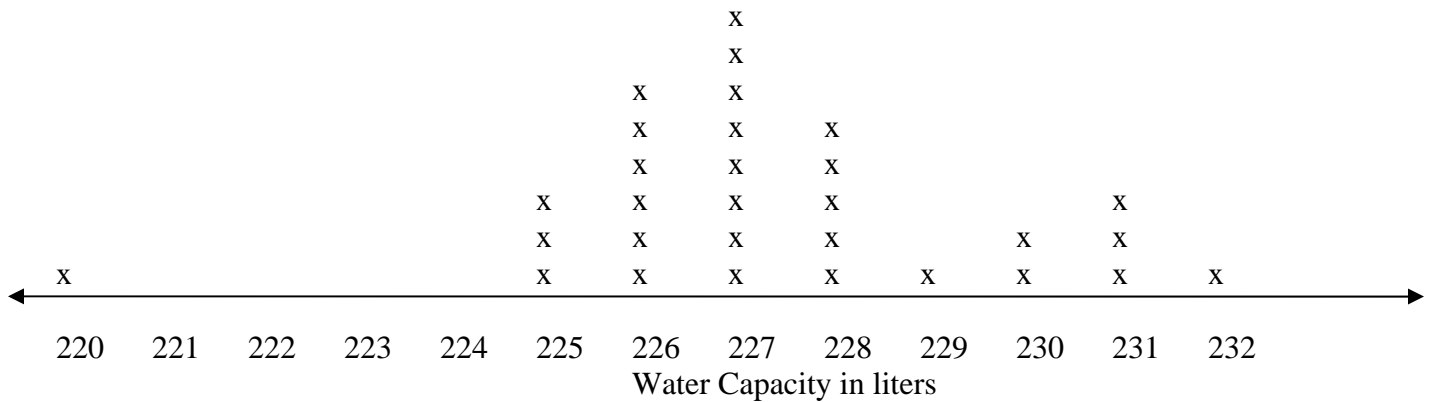
Mode = 320 pounds

Median = 260 pounds

ELVIS: 300 pounds

Water Data Line Plot

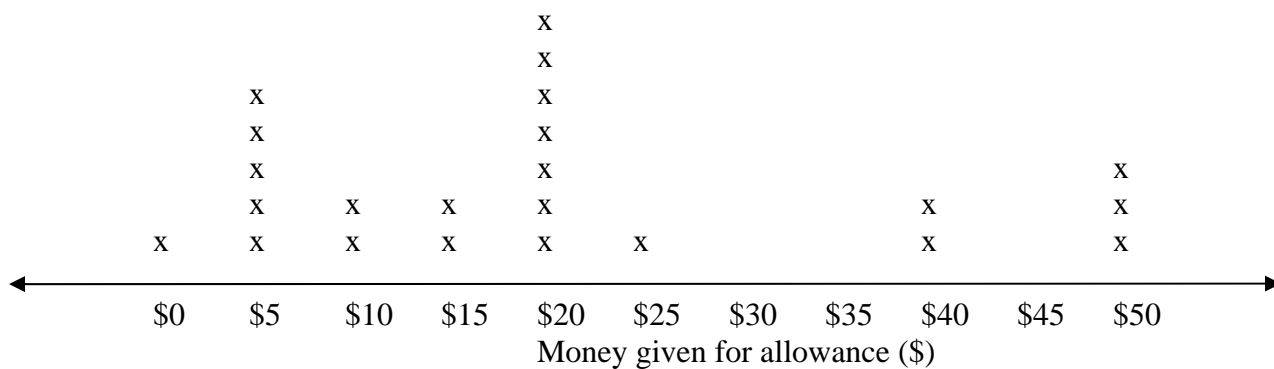
{222, 225, 225, 225, 226, 226, 226, 226, 226, 226, 227, 227, 227, 227, 227, 227, 227, 228, 228, 228, 228, 228, 229, 230, 230, 231, 231, 231, 232}



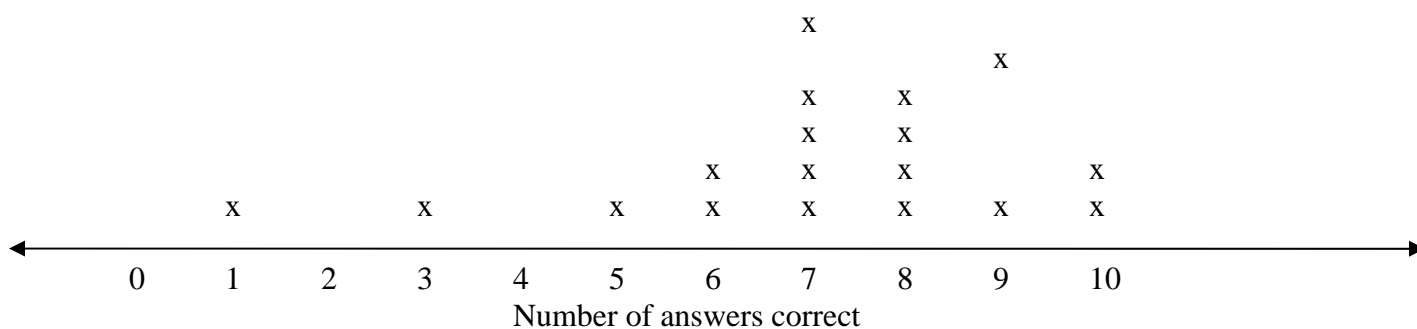
Range = 12 liters
Mode = 227 liters
Median = 227 liters

ELVIS: 220 liters

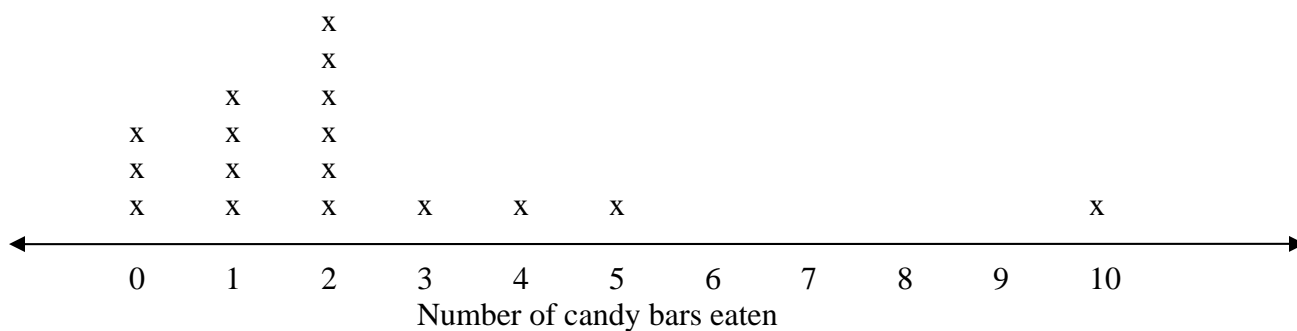
Allowance per week



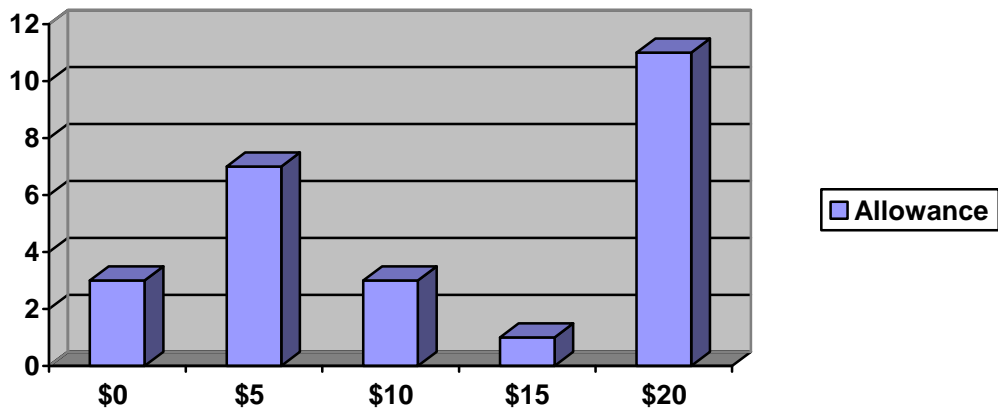
Grades on a 10-Point Quiz



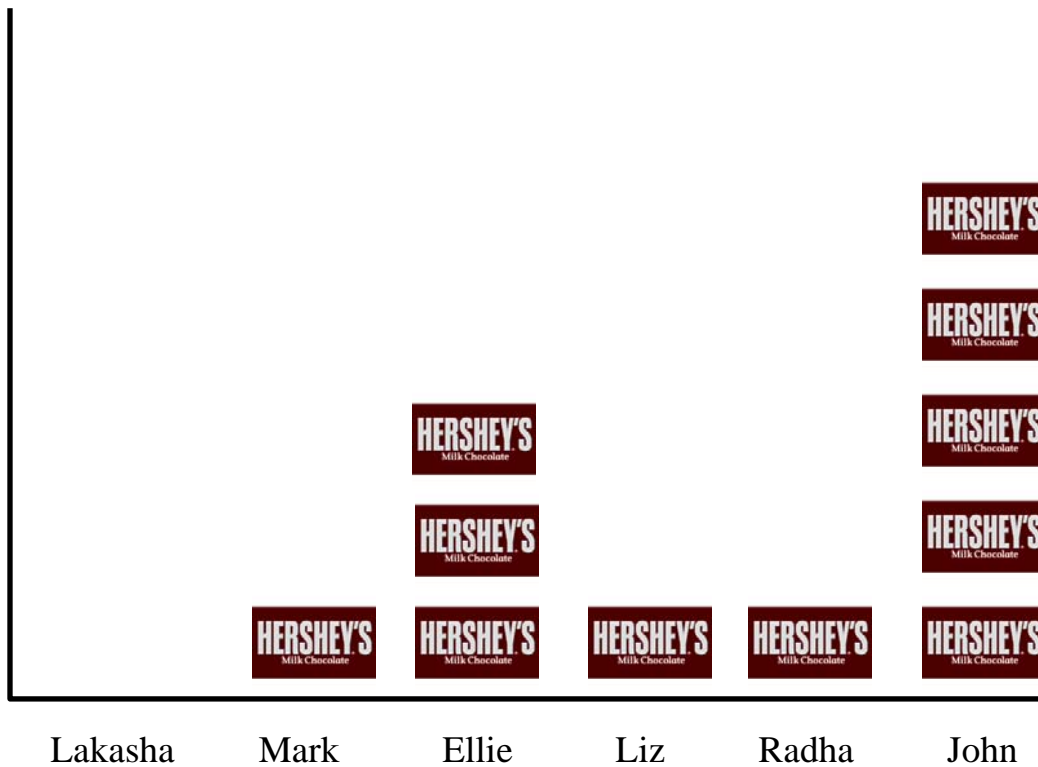
Candy bars eaten in a week




Various other types of graphs:



Candy Bars Eaten in a Week



 = 2 Candy Bars

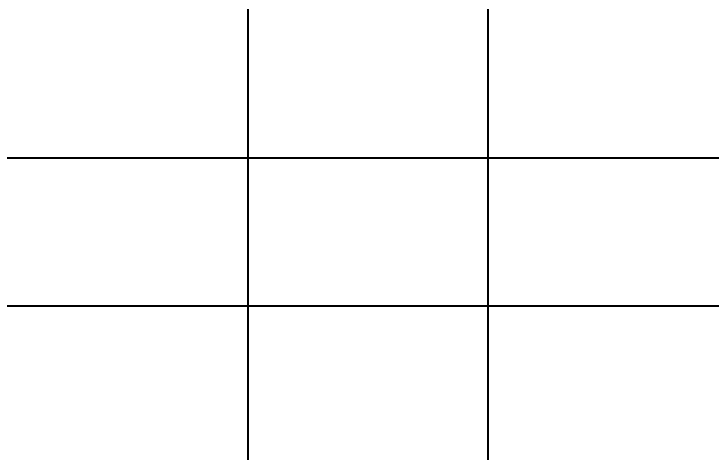
Materials:

- Plain paper for students to draw game board
- Coins or game markers

Directions:

1. Write the Word Box on the board for all students to see.
2. Tell students:
 - Draw a tic-tac-toe board.
 - Choose 9 (nine) words from the word box.
 - Write those 9 words in each of the nine spaces on the tic-tac-toe game board.
Every student's tic-tac-toe game board should be different.

Word Box:			
<i>data</i>	<i>line plot</i>	<i>mode</i>	<i>median</i>
<i>range</i>	<i>labeling</i>	<i>spacing</i>	<i>table</i>
<i>clusters</i>	<i>outliers</i>		



3. Give the definition of each word. Students use a coin or marker to mark the words that match the definition. The one who wins will have crossed off 3 words in a row (horizontal, vertical, or diagonal).
4. The student who has won must tell the definitions of the winning words.
5. Continue the game for 2nd and 3rd place winners, or start over.

2	2	2
3	3	3
3	3	4
4	4	4

4	4	4
4	4	5
5	5	5
5	5	6

6	6	6
6	9	11

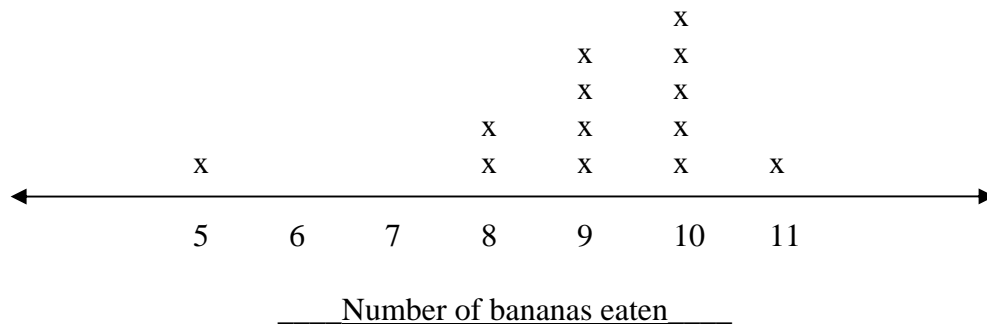
Name _____

Data: Bananas Eaten in a Day by the Zoo's Monkeys

{8, 5, 9, 11, 10, 9, 10, 8, 10, 10, 9, 10, 9}

3. Make a line plot showing the amount of bananas the monkeys ate.

Banana's Eaten in a Day by the Zoo's Monkeys

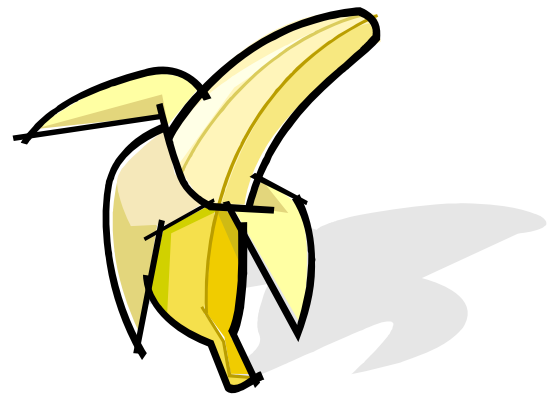


7. Determine the measures below:

Range = 6 bananas

Mode = 10 bananas

Median = 9 bananas



8. There is one outlier in this data. Explain why this may have occurred.

Students should explain that the outlier could be explained by a sick monkey,
or by a baby monkey, or even by the monkey who had his head stuck in a
coconut. Students should further explain that they know this because sick
monkeys, baby monkeys, or monkeys with coconuts stuck on their heads eat less,
and that could explain their difference from the norm.

Extension Question (optional):

You are the Monkey House Manager. Write a letter to the head zookeeper about how many bananas the typical monkey eats in a day. She will need to order next week's food. Help her understand how much she should order for the whole week.

Dear Zookeeper,_____

Our monkeys each eat about 9 bananas per day. I know that because it is the
median of our data, and the median takes all data into account to find the typical
amount. We have 13 monkeys, so our monkeys eat on average $(13 \times 9 = 117)$ 117
bananas in a day. To find the number of bananas eaten in a week, I multiply by 7
 $(117 \times 7 = 819)$. Thus, we'll need 819 bananas for the week.

Thanks!_____

Your
employee,_____

—

Student_____
